

APPENDIX E

Evaluation of LCCHP in Terms of Performance Standards for OU9, 2003 – 2005

Appendix E

Evaluation of LCCHP in Terms of Performance Standards for OU9

The performance of the LCCHP in meeting the remedial action objectives established by EPA for OU9 was evaluated using data collected by the program during the calendar years 2003, 2004 and 2005. The following report summarizes steps taken to assemble and analyze those data and presents the results of evaluation of the data in accordance with the *Methods and Standards for Evaluating the Performance of the LCCHP* prepared by the LCCHP Performance Standards Working Group (July 2002).

For the purposes of evaluating the program's performance, OU9 is subdivided into two areas, described as Statistical Units. Statistical Unit 1 includes the previously defined subareas A, B, D and E, or the areas within the City of Leadville and Stringtown (Figure 1-1). Statistical Unit 2 includes the subareas C, F and G (Figure 1-1). As stated in the *Methods and Standards* document, the remedy for a Statistical Unit will be considered complete when the following performance standards are achieved.

Standard 1

The total number of blood lead program participants from the Statistical Unit over the preceding 3-year period (i.e., the sum of the number of participants for each of three running years) shall be at least 180 children (age 6-72 months), and the 3-year average recruitment of newly eligible individuals shall be 50% or greater.

Standard 2

Based on the consolidated blood lead data set for the three year period, the calculated P10 value shall be 5% or less, and the calculated P15 value shall be 1% or less, with no individual P10 value in any of the three years exceeding a value of 8%.

Standard 3

Based on the consolidated blood lead data set for the three year period, the probability shall be less than 5% that the true P10 value exceeds 7%, and the probability shall be less than 5% that the true P15 value exceeds 2%.

Standard 4

Based on the set of soil lead data for blood lead program participants during the preceding three year period, the proportion of soil lead values above the 70th percentile of the Statistical Unit as a whole will not be significantly lower than 30%, unless the reason for the difference is unavoidable.

Performance Standard Data Compilation

The types of data used in the performance evaluation included:

- number of children under six years old participating in the blood lead monitoring program each year (children having at least one test that year);
- estimate of number of newly eligible children, each year, from kindergarten enrollment from Margaret J. Pitts Elementary School and Joyful Noise Kindergarten and live birth count from the Colorado Department of Public Health and Environment;
- annual average (arithmetic mean) blood lead levels for each child tested in each of the three years;
- individual first-test results for children tested in each of the three years who resided at properties that had soil investigation results; and
- soil investigation data for all properties investigated through 2005 by the LCCHP.

Conventions used to select blood lead test results for inclusion in the annual average for each child and in the annual summary for tested children were consistent with the data reduction approach included in Attachment 8 of the *Methods and Standards* document. The 2005 blood lead data used for the performance standards evaluation are consistent with those presented in this 2005 annual report.

If there are any children with elevated blood lead levels attributable to sources outside of OU9 or beyond the control of the LCCHP, those children's test results are excluded from the annual data reports. No children were eliminated from the 2005 data set.

To complete the evaluation of Standard 4, soil investigation results were compiled by computing an average lead concentration in yard soil for each of the tested properties using all the reported results for soils collected from the 0- to 6- inch depth interval and from the surface-to-root-zone depths of garden bed areas (typically from the surface to 4-8 inch depths). At each sampled property, the average yard-soil concentration is a simple arithmetic mean. There is no weighting for areas represented by each sample because representative areas are not estimated for most of the samples collected by the LCCHP. This approach provides a general description of the average lead concentrations in yard soil, but these values may be biased by the numbers of samples collected in different areas of the yard.

For investigated properties where soil remediation has already been completed, post-remediation soil-lead data are typically not available. In these cases, a substitute value of 200 mg/Kg is assigned to the property as the average yard-soil lead concentration. Given the statistical method used to compare average soil lead values (comparisons of upper percentiles from two data sets), the substitution value used at the low end of the data distribution is not critical (i.e., does not influence the comparison test result).

Each child's first test date and residence address were compared to the list of tested and remediated properties. If the child resided at a property with soil-test results, those results were linked to the child. If the child resided at a property with soil-test results, but the property had been remediated before the child's first blood lead test date, then the replacement result for a remediated property, 200 mg/Kg, was linked to the child.

Resulting data sets used for statistical evaluations in the performance standard evaluation are included as Attachment 1.

Statistical Evaluation of Data

The site is divided into two units for statistical evaluation of blood lead levels in young children residing within OU9. The first unit, Statistical Unit 1 (SU1), comprises Areas A, B, D

and E. Statistical Unit 2 (SU2) comprises Areas C, F and G, but because the performance standards have been attained for this area, no further evaluation is required.

The following evaluation steps were completed for SU1:

- For each of the three years (2003-2005), the total number of children tested at ages under 6 years old was counted.
- For each of the three years (2003-2005), the number of children under 6 years old tested for the first time that year was counted.
- For each of the three years (2003-2005), the set of annual average blood lead levels, one value for each participating child, was tested for normality, and P10 and P15 values were identified using a method appropriate to the data distribution.
- For the three years combined, the set of annual average blood lead levels, one value for each child participating in each of the three years, was tested for normality, and P10 and P15 values were identified using a method appropriate to the data distribution.
- For the three years (2003-2005) combined, the soil lead values at properties where tested children resided at the time of their first test were compiled for comparison to the soil lead values at all of the properties tested within the SU.

If the P10 and P15 values identified for annual and three-year combined data sets for an individual SU met their performance standards, then the uncertainty associated with the estimates of the P10 and P15 values is evaluated to determine whether the possible errors associated with those values are acceptable for decision making in accordance with Performance Standard 3.

Results of Statistical Evaluation for Years 2003-2005

The results of the performance evaluation for years 2003-2005 are listed on Table E-1.

Statistical Unit 1 (Areas A, B, D, E)

Table E-1 lists the results for the SU1 performance evaluation. There were 360 children from SU1 tested in 2003, 2004 and 2005 combined. This exceeds the performance standard of 180 for the 3-year time period.

The estimate of newly eligible children tested was completed for the entire site, rather than by SU, because there are no data available to describe the relative proportions of newly eligible children residing in each statistical unit. When compared to the number of new births and number of children enrolling in kindergarten each year, it appears that the number of new children tested from OU9 exceeds the required minimum of 70 percent of the newly eligible children for each year from 2003 through 2005.

The calculated P10 and P15 values for each year and for the three years combined are reported on Table E-1 and shown graphically on Figure E-2. The P10 and P15 values for SU1 in 2005 are 1.5% and 0.2%, respectively. The distribution of the 2005 blood lead data set was determined to be log-normally distributed. A plot of the data distribution and spreadsheet model used for these calculations are provided as attachments in this Appendix. The P10 value for the three years combined (2003-2005) is 4.2%, and the P15 value is 0.8 % within SU1. This dataset is best fit by a log-normal distribution, and the spreadsheet model provided in the *Methods and Standards* document was used to calculate the P10 and P15 values. These results meet the performance standards for the three year P10 and P15 of 5% and 1%, respectively, and continue the downward trend of these values observed over the last 4 years.

The uncertainty analysis (Standard 3) was performed to evaluate errors associated with the P10 and P15 value estimates. The probability of the true P10 value exceeding 7% is less than 1%. The probability of the true P15 exceeding 2% is also less than 1%. Therefore, SU1 blood lead data meet the performance standards. Results of the uncertainty analysis are included in the attachments to this Appendix and include graphical presentations of the frequency and cumulative frequency distribution diagrams.

Regarding soil-lead levels for tested children, the comparison performed to evaluate Standard 4 indicates that 28 percent of the assigned soil lead values for participating children (soil lead at 23 of 83 properties) are greater than the 70th percentile for all soil lead values obtained to date within the statistical unit. Based on the evaluation criteria outlined in the *Methods and Standards for Evaluating the Performance of the LCCHP*, children tested from SU1 reside at properties that adequately represent properties with elevated soil-lead levels within the SU as a whole. Therefore, SU1 meets performance standard number 4.

Statistical Unit 2 (Areas C, F, G)

For SU2, all performance standards were attained at the end of 2002 (i.e., years 2000-2002). Because the highest P10 and P15 values were both from the year 2002, the work group recommended that a test for trend be performed at the end of 2003 using four years of blood lead data rather than just three. The test for trend did not indicate a statistically significant upward trend at the 95 percent confidence level. The remedy is considered complete within Areas C, F and G of OU9, and the P10 and P15 values are no longer being calculated.

Summary

The data collected by the LCCHP from 2003-2005 were used to complete the data analyses required for evaluation of the program's performance during those years. Those analyses indicate that the performance standards have been achieved within both Statistical Unit 1 (subareas A, B, D and E; City of Leadville and Stringtown areas) and Statistical Unit 2 (subareas C, F and G; outlying neighborhoods around Leadville and Lake Fork Mobile Home Park).

The raw data and output from statistical analyses described in this summary are attached for reference.

Table E-1. Performance Evaluation Results, 2003-2005

Performance Standard	Statistical Unit 1 (A, B, D, E)	Standard Met?	Statistical Unit 2 (C, F, G)	Standard Met?
1. The total number of participants is at least 180 for each SU and at least 50% of new eligible children (site wide) participate on average for a 3-yr period.	360 participants over last 3 years; >90% of estimated new eligible children (site wide) for each of 3 years	yes	Standard met in 2002.	yes
2. For a 3-yr period, the calculated P10 value < 5% and the calculated P15 value < 1%; no individual P10 value exceeding 8%.	3-yr P10 = 4.2%, P15 = 0.8% 2003 P10 = 6.0%, P15 = 1.4% 2004 P10 = 4.0%, P15 = 0.3% 2005 P10 = 1.5%, P15 = 0.2%	yes	Standard met in 2002	yes
3. For a 3-yr period, the probability that the true P10 exceeds 7% is less than 5% and the probability that the true P15 exceeds 2% is less than 5%.	Probability that the true P10 exceeds 7% is less than 1% Probability that the true P15 exceeds 2% is less than 1%	yes	Standard met in 2002	yes
4. For children participating over the last 3 yrs, the proportion of associated soil lead values greater than the 70 th percentile value for the entire Statistical Unit is not significantly lower than 30%.	28% of soil lead values for participating children are greater than the 70 th percentile for soil lead values determined to date in Statistical Unit 1.	yes	Standard met in 2002	yes
Final Decision	Statistical Unit 1 has met all performance standards.		Statistical unit 2 met all performance standards at the end of 2002; 2003 results confirmed no increasing trend in P10 and P15 values.	

Appendix E Attachments

Documentation of Data Analyses

Completed to Evaluate Performance of Lake County Community Health Program

2003-2005

Recruitment Rate Estimate

Recruitment Rate in LCCHP Blood Lead Monitoring Program (within OU9 boundaries)

Year	Live-births Count	Kindergarten Count	New Children Moved In	New Eligible Children		First-time Tested OU9	Recruitment Rate w/in OU9
				Lake County	OU9		
1993	92						
1994	96						
1995	112	113				152 (1994+1995)	
1996	114	124				149	
1997	100	117				145	
1998	129	102	10	110	74	88	1.19
1999	133	98	2	131	88	77	0.88
2000	139	115	3	136	91	87	0.95
2001	140	106	-8	131	88	85	0.97
2002	144	103	3	143	96	141	1.47
2003	124	100	-29	115	77	104	1.35
2004	114	100	-33	91	61	94	1.54
2005	124	95	-44	70	47	83	1.77

98-05 average rate = 1.27

Notes:

Live-births Count from Lake County Health Department.

Kindergarten Count from Margaret J. Pitts Elementary School and Joyful Noise Kindergarten based on the number of children 5 years and older on October 1 of calendar year.

New Children Moved In is the kindergarten count this year minus the live births 5 years previous.

New Eligible Children/Lake County is the sum of # of live births from previous year and # of children moved into site.

New Eligible Children/OU9 represents 67 percent of Lake County value.

Participation Rate is the first-time tested count divided by the estimate of new eligible children in OU9.

Italics indicates estimated values. NA = Not Available.

**Statistical Unit 1 P10 and P15 Calculations
and Uncertainty Analysis**

SU1 2005

INSTRUCTIONS

- 1 Enter blood lead values into coulmn B (max = 500 values)
- 2 Press Control C
- 3 Calculated and observed P10 and P15 values are shown below
- 4 Accept if Anderson Darling statistic is less than the critical value

Summary Statistics

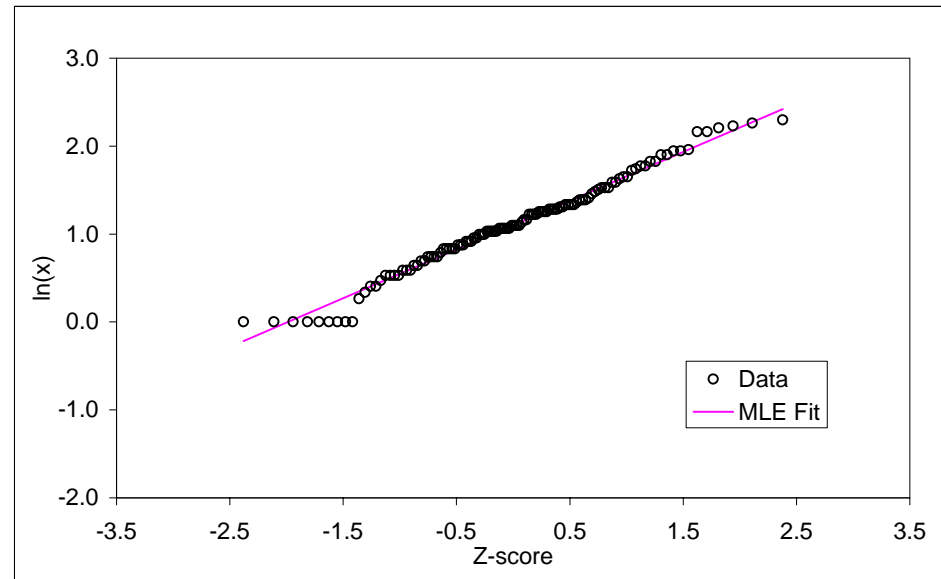
N total 114
 GM 3.01
 GSD 1.74
P10 1.5%
P15 0.2%
 AD Stat -114.636
 AD Critical 0.752
 Decision **Accept LN**

mu 1.10
 sigma 0.56

Anderson Darling Calcs

i	Z(i)	2i-1	n+1-i	Z(n+1-i)	term(i)	Raw AD	Adjusted AD
1	0.02355	1	114	0.02355	-3.772268	-113.8676	-114.6365
2	0.02355	3	113	0.02355	-11.3168	1-alpha	0.950

Rank	PbB	ln(PbB)	ptile	z-score
1	1	0.000	0.009	-2.378
2	1	0.000	0.017	-2.111
3	1	0.000	0.026	-1.942
4	1	0.000	0.035	-1.815
5	1	0.000	0.043	-1.712
6	1	0.000	0.052	-1.624
7	1	0.000	0.061	-1.548
8	1	0.000	0.070	-1.479
9	1	0.000	0.078	-1.417
10	1.3	0.262	0.087	-1.360
11	1.4	0.336	0.096	-1.307
12	1.5	0.405	0.104	-1.257
13	1.5	0.405	0.113	-1.211
14	1.6	0.470	0.122	-1.166
15	1.7	0.531	0.130	-1.124
16	1.7	0.531	0.139	-1.084
17	1.7	0.531	0.148	-1.046
18	1.7	0.531	0.157	-1.009
19	1.8	0.588	0.165	-0.973
20	1.8	0.588	0.174	-0.939
21	1.8	0.588	0.183	-0.905
22	1.9	0.642	0.191	-0.873
23	1.9	0.642	0.200	-0.842
24	2	0.693	0.209	-0.811
25	2	0.693	0.217	-0.781
26	2.1	0.742	0.226	-0.752
27	2.1	0.742	0.235	-0.723
28	2.1	0.742	0.243	-0.695



SU1 2003-2005

INSTRUCTIONS

- 1 Enter blood lead values into coulumn B (max = 500 values)
- 2 Press Control C
- 3 Calculated and observed P10 and P15 values are shown below
- 4 Accept if Anderson Darling statistic is less than the critical value

Summary Statistics

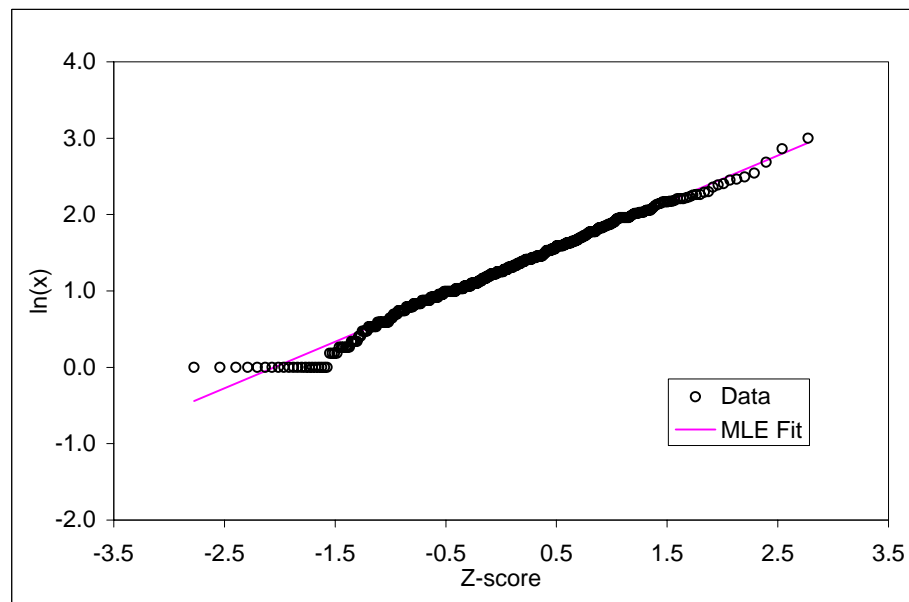
N total 361
 GM 3.49
 GSD 1.84
P10 4.2%
P15 0.8%
 AD Stat -361.713
 AD Critic 0.752
 Decision **Accept LN**

mu 1.25
 sigma 0.61

Anderson Darling Calcs

Rank	PbB	ln(PbB)	ptile	z-score
1	1	0.000	0.003	-2.775
2	1	0.000	0.006	-2.541
3	1	0.000	0.008	-2.396
4	1	0.000	0.011	-2.289
5	1	0.000	0.014	-2.203
6	1	0.000	0.017	-2.130
7	1	0.000	0.019	-2.068
8	1	0.000	0.022	-2.012
9	1	0.000	0.025	-1.962
10	1	0.000	0.028	-1.917
11	1	0.000	0.030	-1.875
12	1	0.000	0.033	-1.836
13	1	0.000	0.036	-1.800
14	1	0.000	0.039	-1.766
15	1	0.000	0.041	-1.734
16	1	0.000	0.044	-1.704
17	1	0.000	0.047	-1.675
18	1	0.000	0.050	-1.648
19	1	0.000	0.052	-1.621
20	1	0.000	0.055	-1.596
21	1	0.000	0.058	-1.572
22	1.2	0.182	0.061	-1.548
23	1.2	0.182	0.064	-1.526
24	1.2	0.182	0.066	-1.504
25	1.2	0.182	0.069	-1.483
26	1.3	0.262	0.072	-1.462
27	1.3	0.262	0.075	-1.442
28	1.3	0.262	0.077	-1.423
29	1.3	0.262	0.080	-1.404

i	Z(i)	2i-1	n+1-i	Z(n+1-i)	term(i)	Raw AD	Adjusted AD
1	0.02028	1	361	0.02028	-3.918565	-360.9566	-361.7127
2	0.02028	3	360	0.02028	-11.75569	1-alpha	0.950



SU1 2003-2005 Uncertainty Simulation

INSTRUCTIONS

1. Enter data in yellow cells
2. Run Crystal Ball simulation to evaluate uncertainty in P10 and P15 values.
3. Characterize results as the probability that the true P10 value is greater than 7%
or the probability that the true P15 is greater than 2%.

INPUT

GM	3.49	GM derived by fitting blood lead data to a lognormal distribution
GSD	1.84	GSD derived by fitting blood lead data to a lognormal distribution
n	361	Number of data points in the blood lead data set

CALCULATED

mu-hat	1.2499
sigma-hat	0.6098
P10-hat	4.21%
P15-hat	0.84%
n-1	360

PDFu(mu)

T(n-1)	-0.48063
Chisq(n-1)	394.912

PDFv

mu	1.26533
var-hat	0.33894
sigma	0.58219
P10	3.7%
P15	0.7%

Monte Carlo Simulation Results			
Percentile	50.0%	95.0%	99.9%
P10	4.2%	5.6%	6.9%
P15	0.8%	1.3%	1.8%

Forecast: P10

Cell: C26

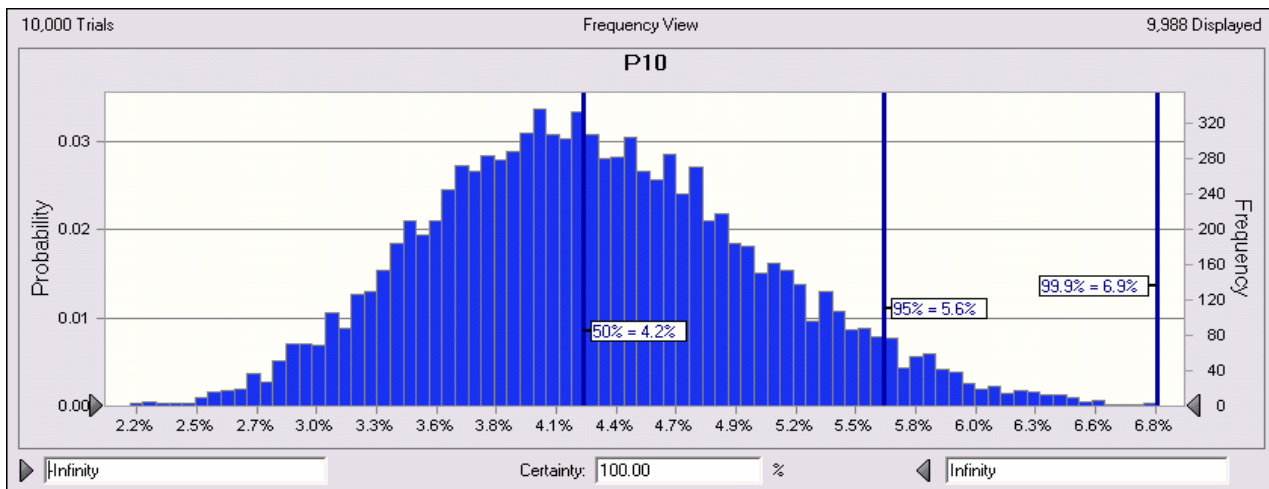
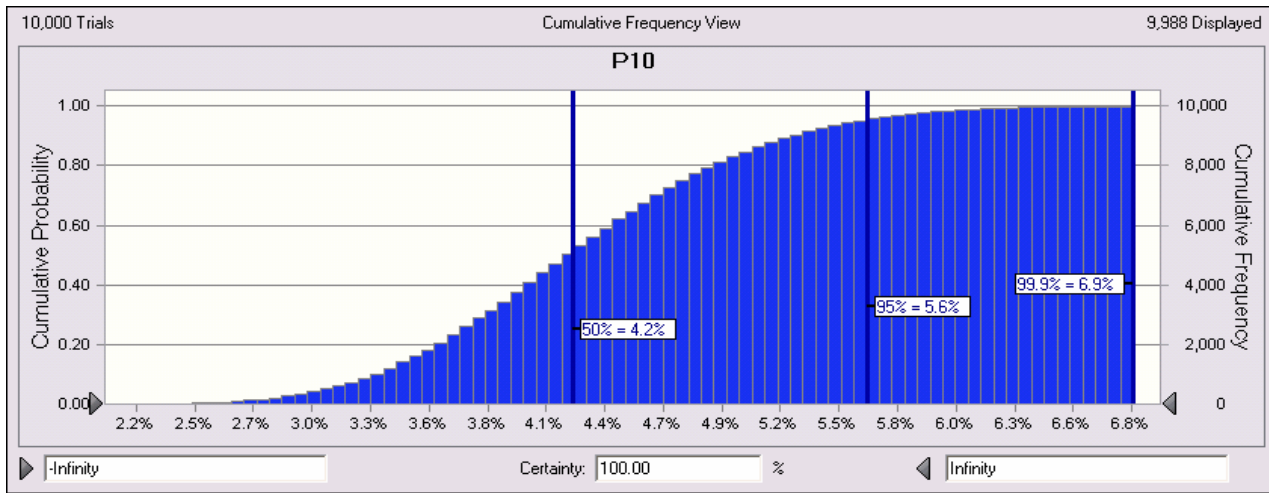
Summary:

Entire range is from 2.0% to 7.8%

Base case is 4.2%

After 10,000 trials, the std. error of the mean is 0.0%

Statistics:	Value
Trials	10,000
Mean	4.3%
Median	4.2%
Mode	---
Standard Deviation	0.8%
Variance	0.0%
Skewness	0.31173
Kurtosis	3.03
Coeff. of Variability	0.17699
Minimum	2.0%
Maximum	7.8%
Range Width	5.7%
Mean Std. Error	0.0%



Forecast: P15

Cell: C27

Summary:

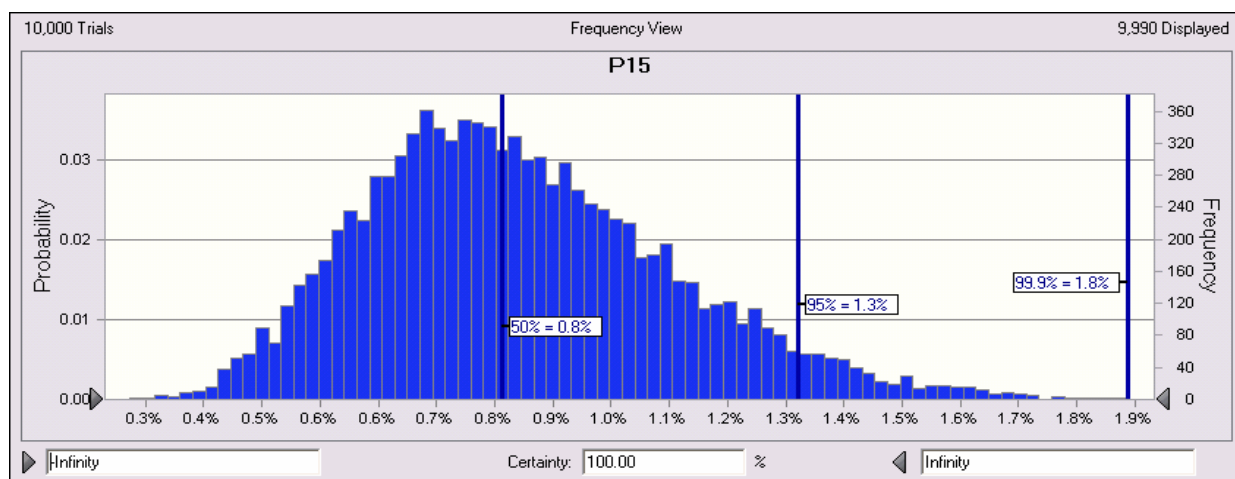
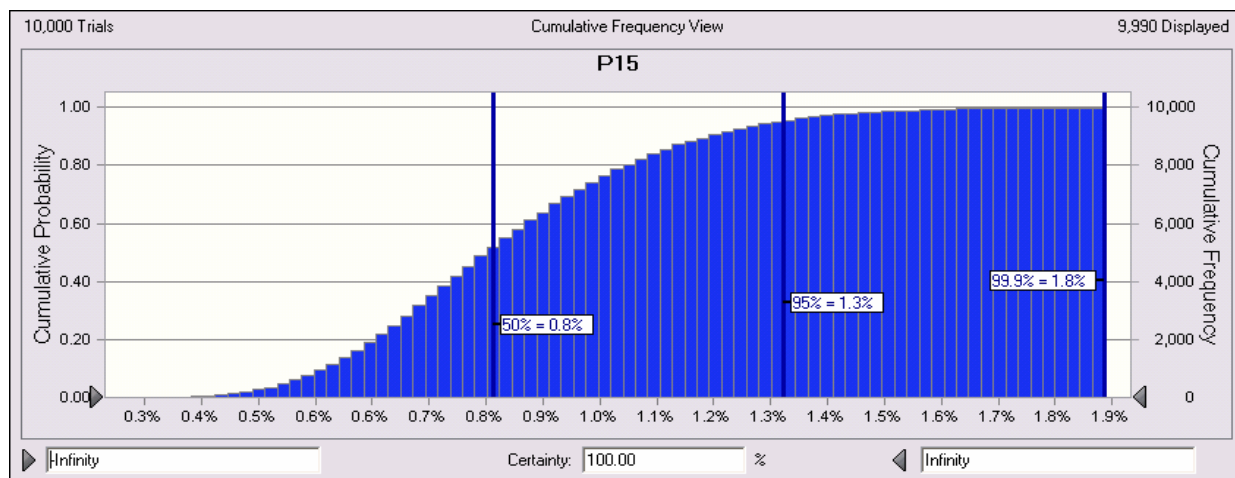
Entire range is from 0.3% to 2.2%

Base case is 0.8%

After 10,000 trials, the std. error of the mean is 0.0%

Statistics:

	Value
Trials	10,000
Mean	0.9%
Median	0.8%
Mode	---
Standard Deviation	0.2%
Variance	0.0%
Skewness	0.61519
Kurtosis	3.49
Coeff. of Variability	0.28118
Minimum	0.3%
Maximum	2.2%
Range Width	1.9%
Mean Std. Error	0.0%



T est Results for Performance Standard 4

Participant Representation of Soil Lead Conditions
Within Statistical Unit 1

SU1 2003-2005

Index	Test Set (R)	Reference Set (S)	R > X?	S>X?
1	11600	18233	1	1
2	4891	9973	1	1
3	4809	9478	1	1
4	4773	8900	1	1
5	4076	8620	1	1
6	3419	8200	1	1
7	3338	7867	1	1
8	3333	7000	1	1
9	2977	6884	1	1
10	2805	6400	1	1
11	2767	6167	1	1
12	2661	5623	1	1
13	2650	5622	1	1
14	2598	5600	1	1
15	2400	5567	1	1
16	2323	5500	1	1
17	2239	5500	1	1
18	2154	5421	1	1
19	2153	5407	1	1
20	2137	5117	1	1
21	1814	4928	1	1
22	1797	4737	1	1
23	1729	4600	1	1
24	1652	4600	0	1
25	1642	4420	0	1
26	1627	4353	0	1
27	1557	4300	0	1
28	1507	4300	0	1
29	1428	4278	0	1
30	1414	4140	0	1

	Counts	GM	GSD
R (test)	83	860	2.8
S (reference)	480	1086	2.9

Cutoff (X)	1679	Alpha	0.05
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Z-test for upper bin		
	Test	Ref
N > X	23	144
N Total	83	480
Phat1	0.277	
Phat2	0.300	
Phat	0.297	
Phat*(1-Phat)	0.209	
z	-0.422	
P(Test<Ref)	0.337	

If P < 0.05, the test set is probably under-representing the high end of the reference data set

CONCLUSION

The soil data PASS Performance Standard 4.

Power	
Delta	0.10
Z(1-a)	1.645
Zb	0.228
Power	59%

If power is low, then a negative result (p > 0.05) may not be reliable

Product
0.199

Performance Standard 4: SU1 2003 - 2005

